INSTRUCTION MANUAL

REGATRON

POWER SUPPLY

MODEL ~~2324~~/232AM

*SERIAL No.*_____

ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED

EATONTOWN · NEW JERSEY

TELEPHONE: (201) LIberty 2-0300 TWX: (201) 542-2273 CABLE: ELMEASCO

Warranty

Electronic Measurements instruments are guaranteed to be free from defects in material and workmanship for one year from the date of purchase (except for tubes, fuses and batteries). Our liability under this warranty is limited to repairs and adjustments or replacements of defective parts or instruments when the fault is a direct result of defective materials or workmanship in the manufacture of the apparatus. This warranty covers service for the first year, except for transportation to and from the factory. If any fault develops in the equipment, the following steps should be taken:

1. Notify ELECTRONIC MEASUREMENTS CO., INC. Give full particulars of the difficulty and include the serial number of the instrument in question. On receipt of this information, we will give you service information or shipping instructions.

2. On receipt of shipping instructions, forward the appartus to us, prepaid, and we will make repairs and adjustments immediately at the factory.

3. If the fault has been caused by misuse, or abnormal conditions of operation, as disclosed by our examination, repairs will be billed at cost. In this case, an estimate of the cost will be submitted before work is started.

ELECTRICAL STANDARDS

All company primary standards are either certified directly or are traceable to certification by the National Bureau of Standards.

CLAIM FOR DAMAGE IN SHIPMENT

This instrument received comprehensive visual and electrical inspections before shipment. Immediately upon receipt from the carrier, and before operation, this instrument should be inspected visually for damage caused in shipment. If such inspection reveals internal or external damage in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. When referring to this instrument, always include the model and serial numbers.

PRELIMINARY INSTRUCTION MANUAL

REGATRON*

MODEL 232A

REGATRON DC POWER SUPPLY

Serial No.____

Issued: May 3, 1956

*Registered U.S. Patent Office. Patents issued and pending

E/M*REGATRON POWER SUPPLY
TABLE OF SPECIFICATIONS

MODEL	DC OUTPUT VOLTS CURRENT	INPUT POWER REQUIRED IN WATTS	DIMENSIONS IN INCHES PANEL HEIGHT	PANEL WIDTH	DEPTH BEHIND PANEL	APPROX. WEIGHT IN LBS.
231A	0-300 0-100ma 0-150 0-5ma 6.3VAC 6 AMP	178	7	19	11½	37
232A	0-300 0-200ma 0-150 0-5ma 6.3VAC 6 AMP	256	7	19	11½	37
233A	0-300 0-300ma 0-150 0-5ma 6.3VAC 6 AMP	320	7	19	11½	37

REGULATION
LINE: 0.1% or 0.1 volts, whichever is greater, for line change from 105 t
125 volts ac, 50-60 cps.
LOAD: 0.1% or 0.1 volts, whichever is greater, from no load to full load.

REGULATION WITH CHOPPER STABILIZATION
LINE OR LOAD: 0.01% or 3 millivolts, whichever is greater.

REGULATION OF 0 TO 150 VOLT DC OUTPUT: 0.5% at maximum setting.

STABILITY: Within 0.1% or 50 millivolts, whichever is greater, for 8-hours after 30-minute warmup under fixed line, load, and temperature conditions, and using precision high-stability external programming resistor.

STABILITY WITH CHOPPER STABILIZATION: 0.05% + 2 millivolts, same conditions as above.

RIPPLE: 1 millivolt RMS maximum with positive or negative output grounded.

OUTPUT IMPEDANCE: Less than 0.01 ohm at low audio frequencies; 0.1 ohm to 10 KC; 1 ohm from 1 to 40 KC.

TRANSIENT RESPONSE: For step change from no load to full or full to no load, output recovers to within dc regulation limits of initial value within 0.5 millisecond.

PROGRAMMING CONSTANT: 1000 ohms-per-volt of output.

REMOTE SENSING: Panel terminals permit sensing of positive and negative output leads.

AMBIENT TEMPERATURE RANGE: -20°C to +45°C.

OUTPUT GROUND: Positive, negative or floating output.

CIRCUIT PROTECTION: Input ac line fused, main dc output fused.

TERMINATIONS: Front: 5-way insulated binding posts. Rear: barrier-type terminal strips. Line cord is 3-conductor type.

CONTROLS: Output voltage controls are wirewound. Panel calibration is approximate.

MOUNTING: Unit fits 19" standard racks and is equipped with rubber feet for table mounting. Top and bottom are protected by perforated metal covers.

FINISH: Smooth gray semi-gloss enamel Class 2 per MIL-E-15090.

*Registered U.S. Patent Office. Patents issued and pending.

I. GENERAL

1. DESCRIPTION:

The Programmable REGATRON is a new type of power supply designed to meet the need for remote control arising out of the increasing tendency towards automation, centralized control, etc. The word, "programmable" has been coined to indicate the fact that the unit may be controlled or "programmed" from a remote or central point. In the design this has been made possible by very simple means, so that the proper control or programming function can be readily incorporated in automatic switching devices.

The circuitry developed for this application embodies a null-balance arrangement which provides unprecedented performance and stability at relatively low cost. Many novel features enhance the usefulness of this unit for general purpose applications.

2. INSPECTION:

After unpackaging the unit, inspect the tubes to see that they are securely in their sockets. Enclosed units may be inspected internally by removing the cover screws and sliding the cover backwards.

II. INSTALLATION

1. POWER:

This unit requires a source of 105 to 125 volts A.C. at 50 to 60 cps.

2. PLACEMENT:

Cabinet units may be placed on a flat surface on the rubber feet provided. Rack units may be located in the same fashion or attached to a rack panel having standard rack drilling. When placing the unit in position, ventilation openings should be left clear. If mounted in a rack, this consideration should be kept in mind.

III. OPERATION

WARNING

Lethal voltages appear at the output terminals and at various points within the unit. In operation, great care should be observed to avoid accidental contact with any exposed load connections or leads. Load connections should be made with the power off.

1. PRELIMINARY:

General Purpose Use: This unit may be used as a general purpose power supply. To so employ it, proceed as follows:

a. Place the switches and controls in the following positions:
   (1) Line and high voltage switches - off (down).
   (2) H.V. control and vernier - Minimum (counterclockwise).
   (3) Bias control - Minimum (counterclockwise).
   (4) Local remote switch - Local.

b. Make load connections to the binding posts at the front of the unit. The grounded post should securely compress the connecting device or lead as well as the grounding link.

c. Plug the line cord into an outlet providing 115 volts A.C. at 50 to 60 cycles. Operate the line switch to the "on" position (green indicator will glow).

d. Wait one minute and apply voltage to the load by operating the high voltage switch to the on position (up). This will be indicated by the red indicator light.

2. ADJUSTMENT OF VOLTAGES:

All the panel controls are approximately calibrated, hence voltages can be set approximately without the use of meters.

a. Bias: The bias is adjustable from 0 to -150 using the approximate panel calibration. The positive terminal of this output is permanently connected to the negative terminal of the high voltage.
   Note: Bias is not turned off by the H.V. switch.

b. High Voltage and Vernier Controls: These controls may be set in the obvious manner except that the output voltage will be the sum of both readings; thus the vernier will add from 0 to 30 volts at any point in the range. If a high order of stability is required for voltages below 30 volts, the main control may be left at zero and the vernier used alone.

3. REVERSAL OF POLARITY:

This power unit has been designed so that either side of the high voltage may be grounded to the case as desired. The unit is normally supplied with the negative side grounded. To reverse polarity, loosen the three (3) high voltage binding posts, swing the link to the other post, and retighten the two (2) posts on the link. The load connection for the ground side may be inserted either under the ground post or the grounded terminal.
Note: For local use the black REM post may be used as an additional negative terminal and the red REM post may be used as an additional positive terminal.

4. REMOTE CONTROL USE:

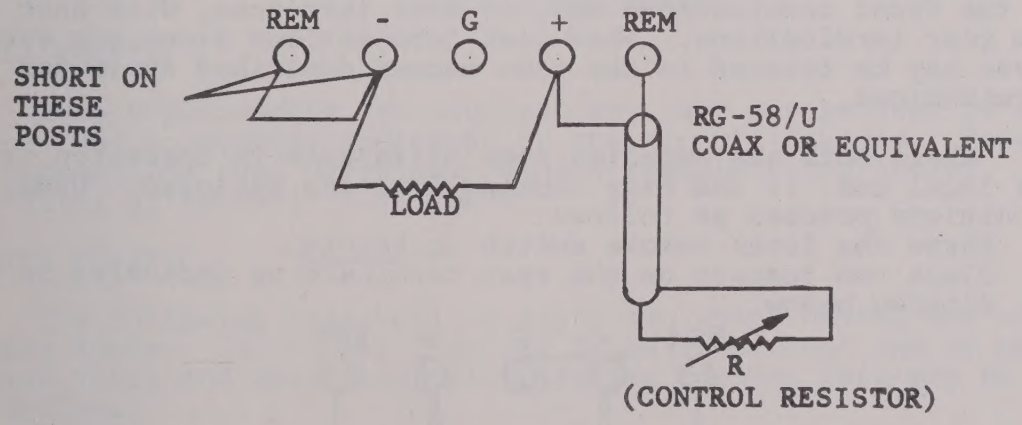
Note: Production units are normally calibrated to make panel calibrations approximately correct. Thus, depending on the tolerance of the internal potentiometer, the calibration may be somewhat more or less than 1,000 ohms-per-volt. Accordingly, if precisely 1,000-ohms-per-volt is desired for remote use, one of the following will be necessary:
(a) Call for 1,000-ohms-per-volt calibration when ordering.
(b) Recalibrate in the field (see below).

Two modes of operation are possible in operating this unit by remote control. They will be described in order of the most probable useage below.

MODE 1:

This method provides remote control without load sensing; therefore, the length of leads between the terminal posts and the load will influence the amount of voltage drop.

a. Throw the local remote switch to REM and make connections as indicated below. Make certain that the outer sheath of the coax line is connected to the plus output post.

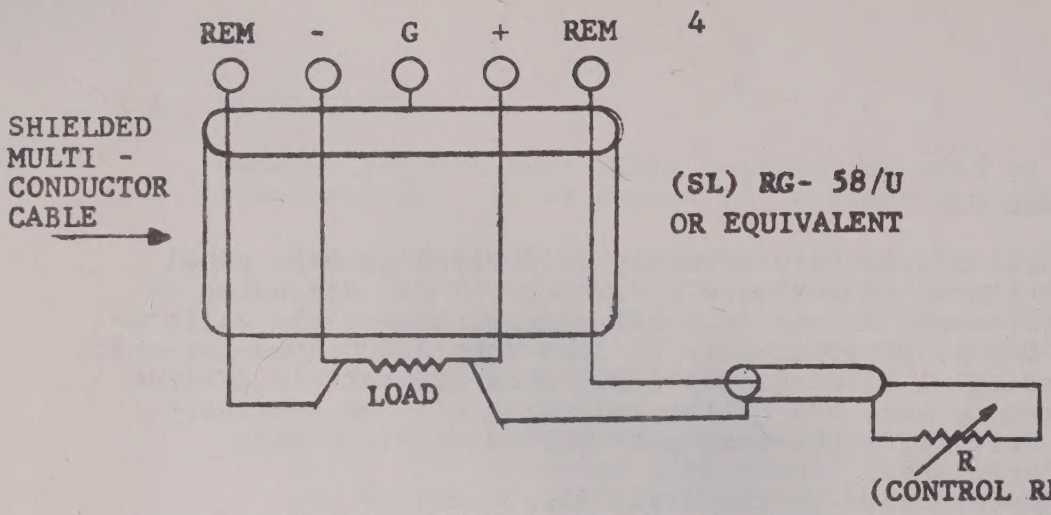


b. Set the high voltage and vernier controls to zero.
c. For each 1,000 ohms inserted at the end of the coax line, 1 volt will be developed by the power supply.

MODE 2:

This method of operation provides sensing at the load and eliminates the effect of lead drop.

a. Make connections as shown on following page.



b. Set the high voltage and vernier controls to zero.
c. As above, one volt will be developed for each 1,000 ohms inserted across the control lines.

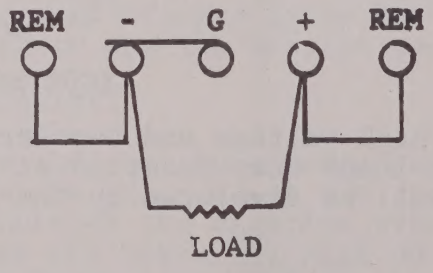
The control resistance R can be employed close to the load, in which case no shielded line will be required. It may also be located remotely from load and power supply, in which case a shielded line (SL) will be required connected as shown in the diagram.

5. REAR TERMINATIONS:

These units may be supplied with rear terminations in place of the front terminations and, in some instances, with both front and rear terminations. When rear terminations alone are supplied these may be treated in the same manner described above for front terminations.

Where both are supplied some difference in operation is involved for local use, if the rear terminations are employed. Under these conditions proceed as follows:

a. Throw the local remote switch to Remote:
b. Place two jumpers on the rear terminals as indicated in the diagram below.



For remote use either set of terminals may be employed in the normal manner. Control will then be derived from the particular set of terminals in use.

6. EXTERNAL REFERENCE:

Reference glow tubes experience a progressive change of voltage with time. For example, a typical change is 1/2% for 1,000 hours of use. Where a highly precise reference voltage is available (negative with respect to the negative bus of the power supply) it may be employed in place of the internal reference by connecting to the terminals provided at the rear for this purpose. To do this proceed as follows:

a. Remove the connections across Terminals 1 and 2.
b. Connect the external reference voltage to Terminals 2 and 3 with the positive side of the external reference connected to Terminal 3.

Any reference voltage of 85 volts or more may be used; however, for each volt over 87 volts, provided by the external reference, 1,000 ohms of resistance should be inserted in the line between the reference potential and the external reference terminal on the unit. For example, if a reference of -150 volts is available, a resistor of 63,000 ohms, ± 1% should be provided. This resistor should be of a wire-wound type with high stability alloy, since it will directly influence the stability of the output voltage.

IV. MAINTENANCE

1. REPLACEMENTS:

When replacements are required any part may be used of the values and tolerances indicated on the circuit diagram. However, replacement of some parts may require recalibration and/or resetting of the null adjustment.

2. SERIES TUBES:

The following instructions apply for units having one or more series tubes. If, at any time, it is believed that one or more series tubes and associated circuits are faulty, this may be checked as follows:

a. Remove all series tubes but one.
b. Turn the equipment on and apply a load of 200 ma. at some low voltage. Check ripple and regulation.
c. Remove this series tube and place another series tube in another socket and repeat b.
d. Repeat b for every other socket and tube, taking one (1) at a time.
e. If one or more of the circuits shows faulty, repeat the test in each case using a tube known to be good.
f. If a favorable result is obtained, it may be taken that the previous tube is faulty. If not, the associated circuits should be checked for faults.

3. NULL-BALANCE ADJUSTMENT:

This unit employs a bridge configuration in the control system. When the system is balanced the principal remaining error is that due to the reference element (an 85A2 reference tube). To null the system, proceed as follows:

a. Connect a voltmeter having a full scale sensitivity of 3 volts or less between the negative high voltage terminal and the null test point on the front panel. Set the null control to obtain a reading of zero. A more sensitive indication may be obtained by alternately connecting and disconnecting the voltmeter.

4. CALIBRATION:

If it is desired to calibrate this unit for external control resistance, proceed as follows:

a. Set up to measure the output voltage either with a precise voltmeter or by a comparison method against an external standard.
b. Perform the null-balance adjustment.
c. Obtain a resistance (R) of a value to provide a good on scale reading for the voltmeter, or equal, to the standard potential available.
d. Connect the unit for remote control under MODE 1 above using the available resistance as the control resistor R.
e. Set the calibration control to obtain the correct voltage.
Note: The procedure for calibration of panel controls is self-evident.

ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED
EATONTOWN · NEW JERSEY

TECHNICAL NOTE 21B
OCTOBER 1959

Regatron Programmable Power Supplies:

The Programming Concept

The Programmable *REGATRON is a new type of power supply designed to meet the need for remote control arising out of the increasing tendency towards automation, centralized control, etc. The word "programmable" has been coined to describe the ability of the unit to be controlled, or programmed from a remote or central point.

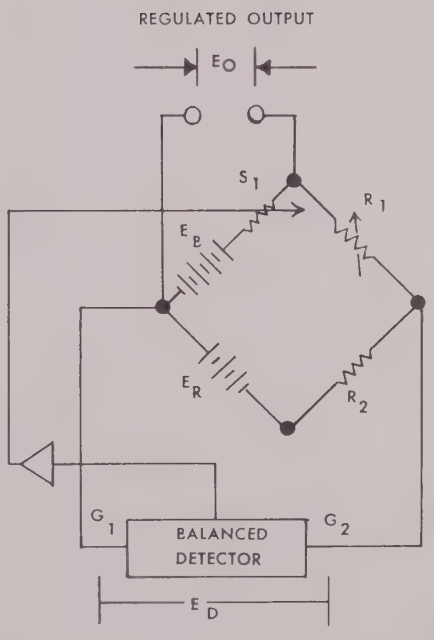
CONTROL METHOD

In the REGATRON control system, programmability is provided by a very simple means.

In Figure 1. E_B is a supply of unregulated voltage, E_0 is the regulated output potential controlled by some sort of series element, S_1; E_R is a reference potential; R_1 is a control resistor; and R_2 is a standard resistor. G_1 and G_2 are the grids of a balanced detector. If matters are so arranged that the voltage E_D at the detector grids is zero, then it must be true that

$$\frac{E_0}{E_R} = \frac{R_1}{R_2} \quad \text{and obviously} \quad E_0 = E_R \times \frac{R_1}{R_2}$$

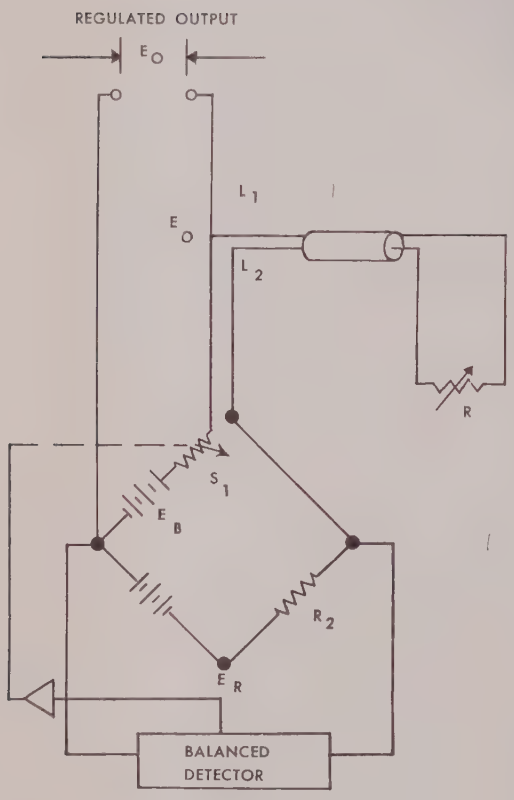
FIGURE 1
CONTROL SYSTEM



*Reg. U. S. Pat. Off.
Patents Pending

FIGURE 2

THE PROGRAMMING FACILITY



However, since E_R and R_2 are constant, then we may say that $E_0 = KR_1$. Under these conditions, therefore, the output voltage is only dependent upon the magnitude of R_1.

With the passage of time, the detector system, even though carefully designed may depart from zero thereby disturbing the above relationship. Accordingly, if means are provided to apply an external detector (such as a meter) to points G_1 G_2, it is only necessary to adjust the balanced detector for zero difference to eliminate control system error. Assuming suitable resistors are employed, the error will then depend entirely on the reference voltage E_R.

REMOTE CONTROL

Figure 2 makes clear the manner in which this system permits simple remote control. Lines L_1 and L_2 may be extended any reasonable distance via coaxial line. Subsequently the system will develop the voltage called for by the resistor R according to the simple law above. By a simple extension of this thinking, connections may be arranged to permit sensing of both load terminals to eliminate the effects of lead drop.

(The above does not, of course, discuss any of the circuit devices employed to produce the requisite gain, operating potentials, etc.)

CENTRAL CONTROL

It is evident from the above, that the voltage controls for all of the power supplies in a test console can be brought to a central operating point, thus facilitating manipulation by the operator. (Figure 3)

The controls at the operator's position can consist of calibrated rheostats, switches and resistors, etc., to provide any degree of control and/or calibration desired.

PROGRAMMING SUGGESTIONS

Most automatic systems have switch connections available for auxiliary devices. Thus, if the two wire programming method is employed, it is only necessary to have sufficient contacts to switch in a new resistor for each potential desired. In fact, one side can be made common thus requiring only one tap.

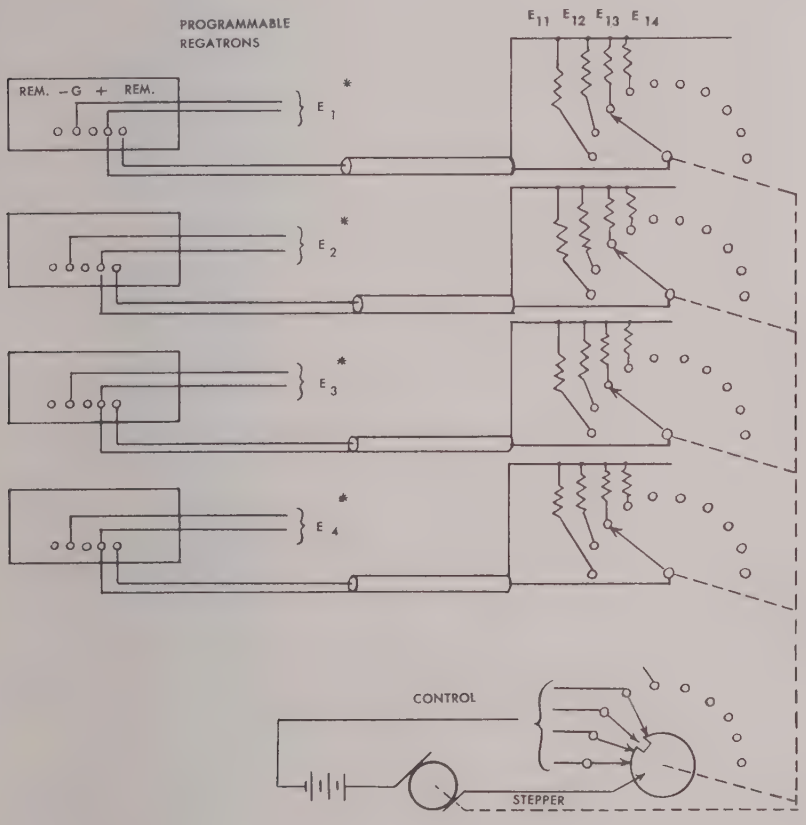


FIGURE 3

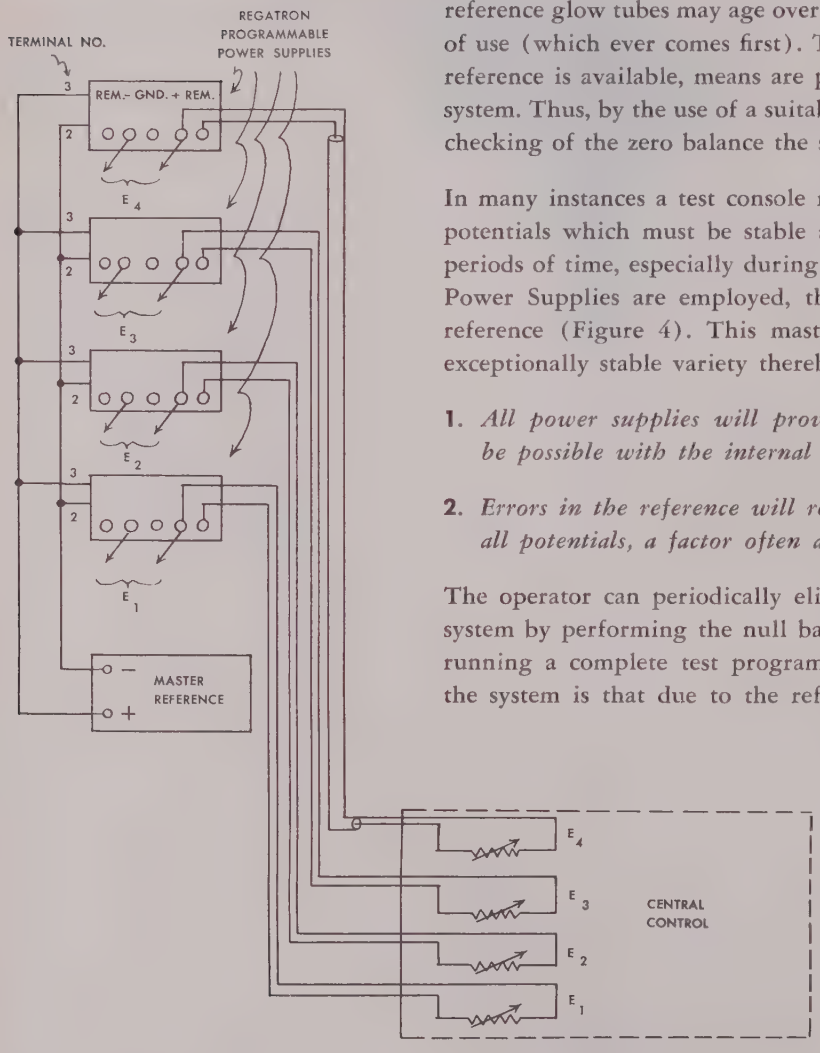
VOLTAGE PROGRAMMING WITH AUTOMATIC STEPPER SWITCH

*E_1-E_2-E_3-E_4 are the useful output voltages to be applied to the points requiring programming. Alternatively, they may be routed through additional automatic switches if redistribution of potentials is required during the program.

However, where suitable contacts are not available, a rotary stepper switch may be employed, each level of which can be used to control a power supply of this type. Thus, if a number are used in a program, say ten, one stepper can be used to set the entire battery to a number of different settings upon command from a central system. An illustrative sketch is given in Figure 3. A large number of possibilities will generally suggest themselves to the user.

FIGURE 4

MASTER REFERENCE SYSTEM



SYSTEM POWER

All units are provided with a suitable internal reference; however, reference glow tubes may age over 1/2% within 1 year or 1,000 hours of use (which ever comes first). Therefore, where a better external reference is available, means are provided for its connection to the system. Thus, by the use of a suitable external reference and periodic checking of the zero balance the system may be as good as desired.

In many instances a test console requires a number of controllable potentials which must be stable and reproducible over substantial periods of time, especially during a test program. If Programmable Power Supplies are employed, they can be slaved to one master reference (Figure 4). This master reference can be made of an exceptionally stable variety thereby giving rise to two advantages:

1. *All power supplies will provide greater stability than would be possible with the internal gas tube reference.*

2. *Errors in the reference will result in the same contribution to all potentials, a factor often as important as absolute stability.*

The operator can periodically eliminate the error of each control system by performing the null balance check (for example, before running a complete test program). The error then remaining in the system is that due to the reference potential.

ELECTRONIC MEASUREMENTS CO., INC.
EATONTOWN, N. J.

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ELECTRICAL PARTS LIST

MODEL 231A/AK,232A/AK,233A/AK

Programming Constant
1000 ohms-per-volt
105-125 volts, 60 cps input

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
*C1-5	Capacitor, electrolytic, 80 uf, 450 vdc, insul. sleeve	D15991	Sprague
C6	Capacitor, mica, 15 uuf ±5%, 500 vdc	CM20B-150-J	Micamold
C7	Capacitor, mica, 220 uuf ±5%, 500 vdc	CM20B-221-J	Micamold
*C8	Capacitor, electrolytic, 25 uf, 25 vdc, insul. sleeve	KE-25/25	Frako
C9	Capacitor, paper, 0.5 uf ±20%, 600 vdc	IMP-0.5/600	Pyramid
*C10	Capacitor, electrolytic, 16 uf, 600 vdc	MC-16/600	Pyramid
CORD	Cord set, 7 ft. lg., 18 gauge, 3 cond., 3-prong plug	346-B-52	EMC
CR1,2,5, 6,7	Rectifier, selenium (231A/AK)	8J1	Radio Receptor
*CR1-CR7	Rectifier, selenium (232,233A/AK)	8J1	Radio Receptor
*CR8	Diode, silicon	HC-69	Solitron
*CR9	Rectifier, silicon	CER71	Solitron
*DS1,2	Lamp, 6.3 volts, 0.25 amp	44	G.E.
*DS3	Lamp, neon	NE-2	EMC
E1,2	Post, binding, red	29-3R	Grayhill
E3-E9	Post, binding, black	29-3B	Grayhill
E10	Shorting link	938-L	General Radio
E11	Shorting link	141-J	Cinch-Jones
*F1	Fuse, cartridge, 5 amps	3AG5	Sightmaster
*F2	Fuse, cartridge, 1/8 amp (231A/AK)	3AG1/8	Sightmaster
*F2	Fuse, cartridge, 1/4 amp (232A/AK)	3AG1/4	Sightmaster
*F2	Fuse, cartridge, 3/8 amp (233A/AK)	3AG3/8	Sightmaster
J1	Tip jack, nylon, black	105-603	E.F. Johnson
J3	Socket, octal (231,232,233AK)	9977	Cinch-Jones
M1	Milliammeter, 0-100 madc ±2% full scale (231AM/AMK)	Model 649/ MA100	EMC
M1	Milliammeter, 0-200 madc ±2% full scale (232AM/AMK)	Model 649/ MA200	EMC
M1	Milliammeter, 0-300 madc ±2% full scale (233AM/AMK)	Model 649/ MA300	EMC
M2	Voltmeter, 0-300 vdc ±2% full scale	Model 649/ V300	EMC
R1,2	Resistor, fixed, comp., 82k ±10%, 2w	HB-8231	Allen-Bradley
R3	Resistor, fixed, comp., 4.7 megohms ±10%, 1/2w	EB-4751	Allen-Bradley
R4	Resistor, fixed, comp., 1.0 megohm ±10%, 1/2w	EB-1051	Allen-Bradley
R5	Resistor, fixed, comp., 1000 ohms ±10%, 2w	HB-1021	Allen-Bradley
R6	Resistor, fixed, ww, ceramic, 4000 ohms ±5%, 10w	'Koolohm' 10KT4K	Sprague
R7	Resistor, fixed, comp., 3600 ohms ±5%, 1w	GB-3625	Allen-Bradley
R8	Resistor, fixed, comp., 5600 ohms ±5%, 1w	GB-5625	Allen-Bradley
R9	Resistor, fixed, comp., 330k ±10%, 1w	GB-3341	Allen-Bradley
R10	Resistor, fixed, comp., 390k ±10%, 1w	GB-3941	Allen-Bradley
R11	Resistor, fixed, comp., 5100 ohms ±5%, 1w	GB-5125	Allen-Bradley
R12	Resistor, fixed, ww, vitreous enamel, 10k ±5%, 20w	Type 'Brown Devil'	Ohmite
R13,14	Resistor, fixed, comp., 100k ±10%, 1/2w	EB-1041	Allen-Bradley
R15	Resistor, fixed, comp., 330k ±10%, 1/2w	EB-3341	Allen-Bradley
R16	Resistor, variable, ww, 30k ±5%, 3w, linear taper, 1/4 in. dia., 1/2 in. lg. shaft, series 58	CM22169	Clarostat
*R17	Resistor, variable, ww, 300k ±2%, 8w, linear taper, 3/8 in. dia., insl. shaft	976-S11	General Radio
*R18	Resistor, fixed, ww, 3000 ohms ±1%, 1/2w	Type TX-178	Precision Resistor
*R19	Resistor, fixed, ww, 76k ±1%, 3w	Type P3W	Precision Resistor
*R20	Resistor, variable, 10k ±5%, 2w, linear taper, 1/4 in. dia., 1/8 in. lg. slotted shaft, series 43	CM18924	Clarostat
R21	Resistor, fixed, comp., 220k ±10%, 1w	GB-2241	Allen-Bradley
*R22	Resistor, variable, ww, 3000 ohms ±5%, 2w, linear taper, 1/4 in. dia., 1/8 in. lg. slotted shaft, series 43	CM18923	Clarostat
R23	Resistor, fixed, comp., 150k ±10%, 1w	GB-1541	Allen-Bradley
R24	Resistor, fixed, ww, 1.0 ohm ±5%, 1w	BW-1	Int'l Resistor
*R25	Resistor, variable, ww, 50k ±5%, 3w, linear taper, 1/4 in. dia., 1/2 in. lg. shaft, series 58	CM20403	Clarostat
R26,27, 29,30, 32,33, 35,36, 38,39	Resistor, fixed, comp., 47 ohms ±10%, 1w	GB-4701	Allen-Bradley
R28,31, 34,37, 40	Resistor, fixed, comp., 470 ohms ±10% 1w	GB-4711	Allen-Bradley

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
*S1	Switch, toggle, SPST	160-73	Carling Electric
*S2	Switch, toggle, DPDT	2GL-53-73	Carling Electric
*S3	Switch, toggle, DPST	2BK-62-73	Carling Electric
T1	Transformer, filament and power	5001	EMC
TB1	Barrier strip, 3 terminals	3-141-Y	Cinch-Jones
TB2	Barrier strip, 9 terminals (rear terminations only)	9-141-Y	Cinch-Jones
*V1,2	Electron tube	GZ-34/5AR4	Amperex
*V3,5	Electron tube	OA2	RCA
*V4,6	Electron tube	OB2	RCA
*V7	Electron tube	85A2/OG3	Amperex
*V8	Electron tube	6AU6	RCA
*V9,10	Electron tube, neon	EM10	EMC
*V11	Electron tube (231,232,233A)	12AX7	RCA
*V11	Electron tube (231,232,233AK)	12AY7	G.E.
*V12-V16	Electron tube	6L6GB	Sylvania
XDS1	Holder assembly, pilot lamp, green faceted lens	100	Drake Mfg.
XDS2	Holder assembly, pilot lamp, red faceted lens	100	Drake Mfg.
XF1,2	Extractor post, fuse, miniature	342003	Littelfuse
XV1,2, 12-16	Socket, octal	9977	Cinch-Jones
XV3-XV8	Socket, 7-pin miniature	53P24022	Cinch-Jones
XV11	Socket, 9-pin noval	14502	Cinch-Jones

ELECTRICAL PARTS LIST

CHOPPER STABILIZER UNIT
336-A-32/349-A-17

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
C1	Capacitor, mica, 27 uuf ±5%, 500 vdc	CM19B270J	Arco
C2,3,4	Capacitor, mylar, 0.022 uf ±10%, 200vdc	107-0.022/200	Pyramid
*C5	Capacitor, tantalum, etched foil, non polarized, 20 uf ±20%, 25 vdc	TAE20-25SDLK-NP	Int'l Electronics
*K1	Chopper, SPDT, 6.3 vac, 60 cps	Model 175	Airpax
P3	Plug, octal	86-CP8	Amphenol
R1	Resistor, fixed, comp., 120k ±10%, 1/2w	EB-1241	Allen-Bradley
R2	Resistor, fixed, comp., 33k ±10%, 1/2w	EB-3331	Allen-Bradley
R3,6	Resistor, fixed, comp., 4.7 megohms ±10%, 1/2w	EB-4751	Allen-Bradley
R4	Resistor, fixed, comp., 100k ±10%, 1/2w	EB-1041	Allen-Bradley
R5,7	Resistor, fixed, comp., 680k ±10%, 1/2w	EB-6841	Allen-Bradley
R8	Resistor, fixed, comp., 56k ±10%, 1/2w	EB-5631	Allen-Bradley
R9	Resistor, fixed, comp., 270k ±10%, 1/2w	EB-2741	Allen-Bradley
R10	Resistor, fixed, comp., 1.0 megohm ±10%, 1/2w	EB-1051	Allen-Bradley
*V1	Electron tube	12AX7	RCA

PARTS LIST ADDENDUM

198-242 volts, 60 cps input

REFERENCE SYMBOL	DESCRIPTION	TYPE OR PART NO.	MANUFACTURER
*F1	Fuse, cartridge, 3 amps	3AG3	Sightmaster
T1	Transformer, filament and power	5182	EMC

NOTES:

1. *Asterisked parts are recommended spares in quantity of one per reference symbol, except fuses, which are three per reference symbol. When electrolytic capacitors are to be stored as spares for a year or more, request Technical Note 32.

2. Part numbers are indicative of stock employed at the time of compilation of this list. Unless otherwise noted, and except for Electronic Measurements Co. (EMC) numbers, "or equal" parts may be used for replacement. Electronic Measurements Co. reserves the right to replace a part with an "or equal" part.

3. When ordering parts from Electronic Measurements Co., include model and serial numbers of the instrument. Note carefully and include the letter suffix of any transformer number. In case of a discrepancy between a parts list number and the number actually printed on the part, employ the latter.

REVISIONS					
REV	DESCRIPTION	DATE	BY	CHK	APP
E	REDR & REV PER ECO NO. 0376	8-30-62	E.C.		
F	REVISED PER ECO NO 0480	2-11-63	RJ		

T1 5001

V1 GZ-34/5AR4

V2 GZ-34/5AR4

C1 80 450V

C2 80 450V

R1 82K 2W

R2 82K 2W

V12 6L6GB

V13 6L6GB

V14 6L6GB

V15 6L6GB

R26 47 1W

R29 47 1W

R32 47 1W

R35 47 1W

R28 470 1W

R31 470 1W

R34 470 1W

R37 470 1W

R27 47 1W

R30 47 1W

R33 47 1W

R36 47 1W

V12 THRU V15 6L6's

"X"

"F"

"C"

"F"

F1 5A

S1 LINE

105-125 VRMS 50-60 CPS

CR1 CR2 CR3 CR4 (4) 8J1

C3 80 450V

R3 47M

R12 10K 20W

R11 5.1K 1W

V3 0A2

V4 0B2

V11 12AX7

V8 6AU6

DS1 LINE ON

CR5 8J1

CR6 8J1

CR7 8J1

C4 80 450V

C5 80 450V

C6 15UUF 500V

R10 390K

V5 0A2

V6 0B2

V7 85A2

R4 1 MEG

CR8

R9 330K

R5 1K 2W

R6 4K 10W

R7 3.6K 1W

R8 5.6K 1W

V8 6AU6

C7 220UUF 500V

V9 EM10

V10 EM10

R13 100K

R14 100K

R15 330K

R21 220K 1W

V11 12AX7

R22 3K

C8 25 25V

NULL

R23 150K 1W

"X"

"X"

R

DS2 DC ON

ON

S2 DC

F2 1/4A

M1 0-200MA SEE NOTE 2

M2 0-300V SEE NOTE 2

C9 0.5 600V

R16 30K VERNIER

R17 300K DC CONTROL

NULL TP

R18 3K 1% WW

R19 76K 1% 3W WW

R20 10K CAL

NE

DS3 NE-2

S3 REM LOC

R24 1 1W

CR9

C10 16 600V

R25 50K BIAS

TB2 SEE NOTE 5

REM

+

GND

−

REM

BIAS

LV AC

E1 REM

E2 +

E3 GND

E10

E4 −

E5 REM

E6 BIAS

"F" E7

"C" E8 LV AC

"F" E9

TB1 3 2 1

NOTES:

1. UNLESS OTHERWISE NOTED ALL RESISTANCE VALUES IN OHMS. ALL CAPACITANCE VALUES IN MICROFARADS ALL RESISTORS ARE 1/2 W K=1,000 OHMS; M=1,000,000 OHMS.
2. METERS SUPPLIED WITH MODEL 232AM ONLY
3. ⊘ SCREWDRIVER ADJ ON FRONT PANEL
4. ▭ DENOTES EQUIPMENT MARKING
5. TB2 IS SUPPLIED ONLY ON UNITS WITH REAR TERMINATIONS
6. ON UNITS WITHOUT CONTROLS, VERNIER R16 & D.C. CONTROL R17 ARE REMOVED & CONNECTION MADE DIRECTLY FROM PIN 2 OF V11 (12AX7) TO THE + REM TERMINAL.
7. ON UNITS SUPPLIED FOR MHOGRAMMING, TERMINAL NO. 3 OF TB1 IS CONNECTED TO THE JUNCTION OF R17 & R18 INPLACE OF NEGATIVE REMOTE. FOR MHOGRAMMING REMOVE JUMPER BETWEEN TERM'S 1 & 2 AND USE TERM'S 1 & 3 FOR CONTROL.

DRAWN BY	SG	12/5/60
CHECKED BY	PWG	12/15/60
DESIGNER		/ /
ENGINEER		/ /
APPROVED BY		/ /

SCHEMATIC DIAGRAM

MODEL 232A, 232AM

ELECTRONIC MEASUREMENTS COMPANY, INCORPORATED EATONTOWN, NEW JERSEY

D SIZE 336-D-9 F REV.

SCALE WT. SHEET OF SHEETS